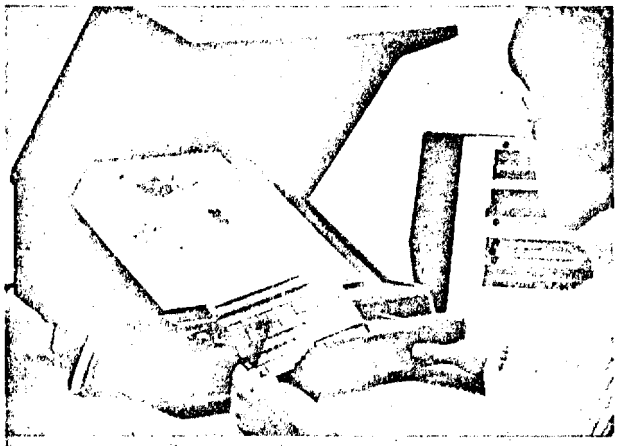
center stage for micrography?

A. A. Aines
National Science Foundation

In the last few years, the computer industry has become familiar with micromedia as a result of the development of computer output microfilm (COM). It may be less acquainted with the extraordinary progress being made in this field apart from COM. In the last decade or less, it has grown into a half billion dollar industry in the United States without any sign of diminishment. Predictions of a billion dollar level in the next few years are believed to be conservative by a number of observers. Interestingly, the field of microphotography received its original stimulation about the time of Babbage. Since then a number of technical developments have made it possible to obtain high-resolution products which are now being exploited at an increasing rate in the public and private sectors. The article covers a number of illustrative examples to show what is happening in this lively field and what accelerants and obstacles are apparent. In summary, it seeks to make a case for recognition of this technological sibling of computers as a powerful new trend in the knowledge industries.

FROM THE EDITOR

You will find, in a pocket on the back cover, a microfiche transparency of the contents of this publication. This will be a feature of succeeding issues. It will give you the option of saving the physical copy, of cuttting it up to place in different files or clipping books, or of total discard to save filing space. If you do not already have your own microfiche reader, keep it anyway. You will probably find one in your library, and Col. Aines has made a good argument for starting your own microfiche library now. Ultimately you may have a small reader of your own.



Shown in the picture is the Honeywell microfiche reader, a front-projection type. The unit is a lightweight office portable, capable of magnification in the range from 18X to 40X.

In his perceptive book, the Age of Discontinuity, Peter Drucker, in probing the future, writes:

> "The impact of cheap, reliable, fast, and universally available information will easily be as great as was the impact of electricity. Certainly, young people, a few years hence, will use information systems as their normal tools, much as they now use the typewriter or the telephone." [1]

Whether or not the assurance that Drucker shows in equating the impact of information with that of electricity will stand the test of time is a matter for future scorekeepers. It is a sweeping statement, however, worthy of reflection. Drucker logically places the computer in the center of this approaching information universe, but he hedges quite properly when he reminds us that information systems without computers are also possible, and may be as important as the systems built around the computer.

While the computer and its associated electronic gear are in the center of our vision today, there are developments in the periphery of information technology that are creating more than ripples of excitement. However the reader may order his universe of new information technology, he would do well to keep acquainted with the vigorous "old-young" industry variously referred to as micropublishing, micrographics, photomicrography, and micromedia.

Just as the digital computer can trace its lineage far back to a number of intellectual and physical milestones, so can its less well-known technological sibling, micrography.

The first microphotograph is credited to an English scientist and optical manufacturer, J. B. Dancer, in 1839. Oddly, this was 5 years after Charles Babbage invented the principle of the analytic engine in 1834, a coincidence that may appeal to computer history buffs. This accomplishment was aided by the just invented daguerreotype photographic process. In 1851, 12 years later, Dancer was able to make microphotographs of higher quality by employing a wet collodion process.

In 1860, the laurels passed to a French chemist, inventor and photographer, R. P. Dragon. He is credited with the first commercial application by producing microphotographs (using Stanhope lenses) on rings, penholders, and other novelties.

The next sweepstakes winner was a German scientist, Dr. Emanuel Goldberg, who is credited as the pioneer of high-reduction photographic techniques. Goldberg, in 1926, invented a grainless, silver collodion emulsion which permitted micrographic reduction to 1/1000 of the original size, still having details resolvable to 1 μm.

The latest inscription in the history of this technology belongs to a team of American scientists, under the leadership of Carl Carlson, which developed in the last decade techniques that permit imposition of high-resolution microimages of more than 3000 pages on a 105 x 149 mm (4 x 6 in) microfiche.

Since the purpose of this paper is less to delve into history and more to appraise the expanding role of microphotography in publishing and information processing, the reader is importuned to take advantage of the growing literature of this field to sate his curiosity in its historical roots.

The statistics of expansion of the microfilm industry are substantial, almost spectacular. Currently, the industry is made up of about 300 companies with an annual dollar volume of more than $500 million. The industry also consists of a couple of hundred service bureaus and about 150 micropublishers. Interestingly, the charts show that the suppliers in this field have doubled in the last 5 years, the number of micropublishers has tripled, while the more familiar COM (computer output microfilm) manufacturers have increased 5-fold. While the expansion of most kinds of industry has not been common in the last few years, the output of microforms in the government alone has increased 7-fold in the last 5 years, and this rate itself appears to be increasing.

Another index of expansion is seen in the appearance of trade and other publications devoted specifically to this field. The National Microfilm Association, a professional society, has a bimonthly publication [2]. On the West Coast of the US are produced a weekly management report on microfilm micropublishing and the computer-microfilm interface [3] and a newsletter [4] that appears every 2 weeks. The East Coast is represented by [5], a monthly report for business executives. Interest in micrographics is not confined to these publications; much information about the field is carried in publications with multimedia coverage.

Some publications are disseminated exclusively in microform. An example is the *International Microform Journal of Legal Medicine*. Other publishers provide their customers with microform copies of their inkprint documents. For example, the American Chemical Society currently offers twenty primary publications on microfilm. This professional society points out that virtually the entire modern history of the chemical world can be housed in a microfilm carrousel measuring about 43 x 43 x 106 cm — about one shelf.

The US Patent Office is converting the 3¼ million patent documents on file into microfilm images. Documents up to eight pages will be reduced to a 45 mm rectangle of 35 mm film, mounted in a standard punch card. Many millions of microfilm pages are being employed in government logistics programs to catalog supplies and maintenance items and to keep control of huge inventories.

Federal research and development agencies are now selling directly or through commercial agents about 20 million microfiche annually of reports resulting from their programs in science, technology and education. The Superintendent of Documents, impressed with the trend, is considering the dissemination of his 70 million or so documents a year in microfiche as well as hard copy. The shift to the plastic transparency is being eyed by many other groups in and out of the government. Concerned with the expansive paperwork of the Federal

Government, the General Accounting Office of Congress is encouraging Federal Agencies to convert to the use of microform wherever practicable.

Dr. Lee Burchinal, Assistant Commissioner, National Center for Educational Communication, US Office of Education, believes that microform application in education, one of the major fields of expansion, is only in its infancy. Pointing out that nearly 400 educational organizations are acquiring almost one million microfiche per month from Educational Resources Information Center (ERIC), he writes: "Libraries are buying a wider range of microforms, now expanded to include referenced works on ultrafiche." [6]

As a result of Office of Education stimulation, a hand-portable microfiche reader is now being marketed. Other manufacturers are entering the low-cost microfiche reader field with book-size readers, which in bulk will sell for about $50 each. It is conjectured that this development may create a new consumer goods industry, a supposition supported by the number of firms producing microfiche readers in the United States and elsewhere.

Adding to the now familiar CAI lore, Burchinal looks into the future and comments:

> "Instead of all children studying the same thing at the same time and the entire class moving in a lock-step motion throughout the semester or year, new teaching approaches stress matching instructional materials and various learning experiences to the learning style, pace, and accomplishment of each child. . . . Implications for the microform industry follow from the movement toward individualizing instruction. . . . Microforms, along with films, filmstrips, records, video tapes, and other media, can share in providing the needed rich array of information. . . . Data requirements for operating an individualized program are enormous. Computerization is the typical answer. . . ." [7]

The realities that are ushering in the Age of Information often parallel the predictions of the visionaries. One example is NASA's RECON (for REmote CONsoles) information retrieval system, which is well beyond the prototype stage. This agencywide network features a central computer in College Park, Maryland, in which about three quarters of a million bibliographic references pertaining to aerospace are stored. Remote consoles/microform stations located in NASA installations are connected to the computer, making possible computer searching and local full-text reading of specific articles stored in the microform file. The RECON system has been employed by European Space Research and Launcher Development Organizations (ESRO-ELDO), and is advertised as the first system of its kind on that continent, an application made possible by means of magnetic tapes shared by NASA. Thus, the NASA RECON system, engineered by Melvin S. Day and his associates, features various kinds of electronic-photographic-IR technologies that combine technology and mission oriented service, a forerunner of similar sophisticated systems serving scientists and engineers.

Although the life of any technology rarely unfolds in a predictable manner, microform technology will probably make its strongest impact if it becomes a conventional and convenient way to transmit information direct to the individual. The development of an economical reader and a reader-printer, which permit the office, school or home reader to both read from microform and selectively convert images to hardcopy, must be considered a long step in this direction. Reader-printers selling for about $300 are now on the market to match the arrival of the $50 to $75 reader which will emancipate the human reader from the traditional book, magazine and newspaper.

Another accomplishment of note is the color microfiche now commercially available. The utility of color microfiche in a number of fields (food, medicine, chemicals, clothing, and others) is obvious; and while the color process is more expensive than black and white, the costs are expected to decrease as volume increases.

An advance that encourages the optimist in this field is the perfection of microduplication techniques and equipment. Now it is possible for the production of microfiche copies from microfiche masters like sausages by means of a machine that probably will become a popular adjunct to libraries and large offices.

While one of the most attractive features of microfiche is the obvious saving of storage space (which is a considerable advantage for libraries, documentation centers, and offices), publishers fighting to survive will probably become more attracted to micropublishing as a result of recent increases in postal service rates. Here the gain is evident. Airmail and regular mail can be used to send materials hitherto economically impossible.

Hyperconscious of the proliferating use of trees converted to newsprint, environmentalists are boosting micromedia as one way to reduce the inroads on our forests. They are prone to point out how many acres of trees are consumed to bring out Sunday newspapers. Other environmentalists are concerned that the polluting effects of microfilm manufacture should not increase seriously, but this is not a large problem, comparatively. Paper makes up about 40 percent or more of all solid wastes in the United States.

John R. Pierce sees in CATV the possibility of the delivery of newspapers to homes by wire. It would call for an extra channel on a CATV network employing economical broadband transmission. He believes that people want big newspapers with lots of advertising, but they do not want these spewed out on their floors unfolded; neither do they want rolls of newsprint stored in their homes. A microfilm newspaper might be acceptable if a number of technical problems could be overcome [8].

As has been repeated so many times, the inexorable march of new technologies is, more often than not, accompanied by new breakthroughs in earlier technologies, and certainly in the way we perceive the old tech-

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nologies. For example, in light of later developments, it is not hard to picture a bookstore with shelves of microfiche books taking their place besides the paper-print volumes. Imagine a student coming away from the university book store with a handful of microfiche transparencies representing all of the books he needs for the semester. Picture the homeowner getting his Sears catalog in the form of a couple of microfiche. Some large corporations have already begun to use ultramicrofilm ("ultra" generally indicates over 70X reduction) to replace their bulky printed directories of parts used in their products.

These and many other applications give substance to the belief that micropublishing poses a palpable threat to conventional book printing. They show why newspapers somehow feel threatened by microform publication, why phototypesetting markets are being eroded by COM, why offset plates are increasingly being made from microfilm rather than traditional materials, and why there is something like an international race brewing for supremacy in the micromedia world.

Despite the rosy colors that illuminate the foregoing, it would be well to look at some of the hazards and barriers that face the micropublishers.

Many people find reading microform less satisfactory than print. This happens even when the reader screens provide clearly readable material. The implication that the user gets microfiche with less than good quality some of the time is unfortunately true. Printed materials come from many sources, some without any sort of quality control in their production. People like to browse and mark up inkprint reports with underlining and marginal comments. Given a free choice, the average user will continue to prefer inkprint documentation over microfiche surrogates or ephemeral images on a television screen. The average user today is, of course, acculturated to hardcopy, hence he can be considered resistant to the use of the microform reader. Thus, it is believed that the young people Drucker alludes to in the opening passages above offer the best hope of accepting microform. Harvey Marron of the Office of Education believes that some of the initial reader discomfort experienced in reading microfiche is diminishing. This may be significant in light of Harold Wooster's earlier study which showed that the reader community he surveyed for their attitudes towards microfiche split down the middle [9].

Another problem involves the availability of good and cheap reader-printers to the users now obtaining inkprint materials. Their initial reaction to the quality of the image and the ease of using the microfiche devices will strongly influence their acceptance of microfiche.

Since new technologies are often initially employed in the same manner as those they displace or augment (early automobiles sported buggy whip sockets), current microfiche practices still follow the custom of inkprint pagination. Observers of the micrographic scene like Norton Goodwin, George Bernstein and others point out that added advantage will accrue when the new medium develops its own formatting rules and customs based on its unique characteristics. There is little to be gained by setting aside blank space for page numbers, margins appropriate for paper pages, and the like, when the name of the game is compaction of material. In this respect, large gains will be registered when microform goes beyond merely archiving, and the shift towards their use for "original" documents becomes well-pronounced. COM expansion should hasten this day.

Another problem involves standardization. Badly needed is a family of acceptable reduction ratios for special purposes. Undoubtedly progress will be held up in the long run for the elusive current advantage accruing to industrial organizations placing new products on the market. So rapid are developments in the micrographic field that traditional standards-making organizations are unable to bring order as rapidly as needed.

From all of these forces, trends, events and barriers, the reader can draw his own conclusion about the vigor of this new field. Up to now, growth has been rapid, but competition with other media is bound to increase, and the invisible pen that traces the curve of progress can move in any direction. The micrographic revolution may result in the fulfillment of Drucker's prediction, if its staying power is equal to the challenge. In which case, it certainly will attain "center stage" status.

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